VOL. I. Ser. A. Part 2.—pp. 33-64. FEBRUARY, 1913.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL BUREAU OF ENTOMOLOGY.

LONDON:

SOLD BY

DULAU & Co., Ltd., 37, SOHO SQUARE W.

Price 9d. net.

3s.

All Rights Reserved.

IMPERIAL BUREAU OF ENTOMOLOGY.

HONORARY COMMITTEE OF MANAGEMENT.

THE EARL OF CROMER, G.C.B., O.M., G.C.M.G., *President.*

Lieutenant-Colonel A. W. ALCOCK, C.I.E., F.R.S., London School of Tropical Medicine.

Mr. E. E. AUSTEN, Entomological Department, British Museum (Natural History).

Dr. A. G. BAGSHAWE, Director, Tropical Diseases Bureau.

Sir J. ROSE BRADFORD, K.C.M.G., F.R.S., Secretary, Royal Society.

Surgeon-General Sir DAVID BRUCE, C.B., F.R.S., A.M.S.

Dr. S. F. HARMER, F.R.S., Keeper of Zoology, British Museum (Natural History).

Professor H. MAXWELL LEFROY, Imperia College of Science and Technology.

Dr. R. STEWART MACDOUGALL, Lecturer on Agricultural Entomology, Edinburgh University.

Sir JOHN MCFADYEAN, Principal, Royal Veterinary College, Camden Town.

Sir PATRICK MANSON, G.C.M.G., F.R.S., Late Medical Adviser to the Colonial Office.

Sir DANIEL MORRIS, K.C.M.G., Adviser to the Colonial Office in Tropical Agriculture.

Professor R. NEWSTEAD, F.R.S., Dutton Memorial Professor of Medical Entomology, Liverpool University.

Professor G. F. NUTTALL, F.R.S., Quick Professor of Protozoology, Cambridge.

Professor E. B. POULTON, F.R.S., Hope Professor of Zoology, Oxford.

Lieutenant-Colonel Sir DAVID PRAIN, C.I.E., C.M.G., F.R.S., Director, Royal Botanic Gardens, Kew.

Mr. H. J. READ, C.M.G., Colonial Office.

The Honourable N. C. ROTHSCHILD.

Mr. HUGH SCOTT, Curator in Zoology, Museum of Zoology, Cambridge.

Dr. A. E. SHIPLEY, F.R.S., Master of Christ's College, Cambridge.

Sir STEWART STOCKMAN, Chief Veterinary Officer, Board of Agriculture.

Mr. F. V. THEOBALD, Vice-Principal, South Eastern Agricultural College, Wye.

Mr. J. A. C. TILLEY, Foreign Office.

Mr. C. WARBURTON, Zoologist to the Royal Agricultural Society of England.

General Secretary.

Mr. A. C. C. PARKINSON (Colonial Office).

Director and Editor.

Mr. GUY A. K. MARSHALL.

Assistant Editor.

Mr. W. NORTH.

Head Office.—British Museum (Natural History), Cromwell Road, London, S.W.

Publication Office.—27, Elvaston Place, London, S.W.

Theobald (F. V.). **The Aphididae of the Hastings District.**—*Hastings & E. Sussex Nat.* ii, part 1, 31st Dec. 1912, pp. 9-20.

The author gives a list of 69 species of Aphididae found in and near Hastings. He recommends that specimens should be kept in glass tubes containing a 4 per cent. solution of formalin, after previous soaking for fifteen minutes in 60 per cent. alcohol.

Vers-à-soie sauvages d'Afrique [Indigenous African Silkworms].—*Quinzaine Coloniale*, 25th Jan. 1913, p. 59.

Recent researches in Uganda have resulted in the determination of three species of indigenous silkworms *Anaphe infracta*, Wlsm., *Hypsoides milleti*, de Juan, and *Mimopacha gerstaeckeri*, Dew. The first-named is the most widely distributed and produces the largest quantity of silk; the imago appears in January and September. The food-plants of the caterpillar are *Bridelia micrantha*, *Cynometra alexandri* and *Triumfetta macrophylla*. The nests of *Anaphe* vary greatly in size, as does also the number of cocoons contained in them. They weigh from 3 to 4 kilos and contain 130-500 pupae; 25 nests will yield about 1 kilo of crude silk. The chief enemies of *Anaphe* are certain birds, which eat the young larvae before their stinging hairs are developed, and also various parasites which attack them at all stages of development.

Fiske (W. F.). **The Gipsy Moth as a Forest Insect, with suggestions as to its control.**—*U.S. Dept. Agric., Bur. Entom., Circ.* 164, 17th Jan. 1913, pp. 1-20.

In the earlier invasions of the Gipsy Moth it was regarded as absolutely omnivorous, though possibly from necessity. It is now no longer prominent as a field and garden pest and the American Tent Caterpillar frequently surpasses it in damage to orchards. Forests have suffered less than was originally expected and generally the situation has improved within recent years.

Causes of the improvement.—The Gipsy Moth is at present most active in a belt of towns beyond the limits of the densely populated metropolitan area, and it is possible that even great destruction in out-of-the-way places has not attracted so much attention as the earlier damage done in the parks of the large towns. But real improvement was noticeable in the metropolitan district and this is probably due to at least four main causes:—(1) the perfection and standardisation of methods for artificial repression; (2) the death of a large proportion of the more susceptible trees or their removal from the infested woodland; (3) the importation of parasitic and predatory insect enemies; (4) the development of the "wilt" disease.

(28535—2.) Wt. P 2601. 2000. 2/13. D & S.

Artificial methods for repression cannot be used in forests, because of their expense. About 30 species of insect enemies of the moth are of importance in checking its increase in Europe and Japan. All the more promising of these species have been imported, and more or less successfully established in America. About one-third of these may be regarded as fully established and as steadily increasing in efficiency. Within an area a little to the north of Boston quite 50 per cent. of the eggs, caterpillars or pupae of the Gipsy Moth in the aggregate were destroyed by imported parasites in 1912. The parasites have not spread over a large area, but are extending every year, and may be increased by artificially assisting the dispersion of certain species.

The principal cause of improvement is the "wilt" disease of the larva, probably due to a bacterium described as *Gynococcus flaccadifex* by its discoverers Messrs. Glaser and Chapman; but this requires confirmation. The disease first appeared between 1903-4 in certain of the worst infested forests, and by 1907 it had spread throughout the whole infested area, reaching a climax about 1911. How the caterpillars originally became infected is not known, but it is believed that the organism is conveyed from one generation to another through the eggs. Simple infection is not sufficient to cause death, but an infected caterpillar can, it is believed, transmit the disease directly to its offspring. A weakening of the caterpillar from some other cause appears to be necessary to produce a fatal result, the contents of the body being resolved into a black liquid and this, fouling the foliage, transmits the poison to other caterpillars. Unfavourable food appears to be directly contributory to the death of the caterpillar, for whereas it used to be easy to rear caterpillars in the laboratory upon lettuce, for example, when they were free from the taint of the disease, it is practically impossible to do so to-day if American eggs are used. If foreign eggs are used from a locality where "wilt" is not prevalent this is not the case. Lettuce is no exception; practically all herbaceous plants and a considerable variety of trees and shrubs appear not to be really suitable foods, at all events for the infected caterpillar.

Artificial utilisation of the "wilt" disease.—The fact that seriously infected caterpillars, provided the food be suitable, will pass through all their stages, throws some doubt upon the utility of spreading the infection by artificial means. Elaborate field experiments with disease-infected food-plants have practically failed; that is to say, it made no difference whether the caterpillars were fed with infected food or not; large numbers died in both cases and no noticeable difference was found between the mortality in the experiments and in the checks. There is also a very great difficulty in securing uninfected caterpillars for experiments. The author is strongly of opinion that results claimed by recent experimenters are misleading for these reasons.

Natural control of the Gipsy Moth abroad.—Mr. Fiske, after personal investigations in Europe, finds that the invasion of some 3 to 7 years ago has spent its force and that in Italy and Germany, at all events, the moth cannot really be described

as abundant. Evidence was discovered of the existence there of an epidemic disorder similar, externally at all events, to the American "wilt" and also resembling the disease of the Nun Moth (wipfelkrankheit). It was also clear that the enormous decrease in numbers caused by this epidemic was not followed by an unusual increase of the remainder, such as has so frequently been observed in America, but rather that a more or less innocuous minimum was reached and maintained for an indefinite or at least protracted period; presumably the result of the operations of parasites.

Serious outbreaks in Sicily and in Calabria extending over a number of years presented the peculiarity that although the number of caterpillars was enormous, in no case was the entire forest defoliated at once, but only after the second or third year. Parasites were abundant, destroying approximately 90 per cent., which was far from sufficient to prevent increase, and the millions of caterpillars which died of starvation and exposure dried up without showing any trace of the decomposition invariably associated with the "wilt." As a result, in the worst infected portions of the forest there were very few eggs, but the caterpillars would always be remarkably healthy the next season, and as the parasites were attracted to the more badly infested parts of the forest, the rate of increase elsewhere was simply astounding. In no locality other than these two, either in Europe or America, has the author been able to find Gipsy Moth unaccompanied by disease, and it is the prevalence of such extraordinary conditions and their similarity to those which prevailed in America before the development of the disease, which convinced him that the present improved conditions are largely due to the prevalence of the "wilt" disease.

The author is of opinion that the methods of forest management in Europe are largely responsible for checking the ravages of the pest, although it is possible that these are the result of long practical experience rather than of scientific observation, and he strongly urges the elimination of those trees most likely to be injured. As a matter of fact their removal is taking place automatically in the United States, in the territories which have been longest infested, but the natural process is accompanied by the unnecessary destruction of other trees and avoidable pecuniary loss.

Observations made in the United States show that the trees may be roughly divided into three groups according to their susceptibility to injury. The first group most affected is composed entirely of the various species of oaks; in the second group are those trees which appear especially favourable to the increase of the moth immediately following its establishment; these are rarely completely stripped and very rarely killed by the moth. The birch and willow are the principal trees in this group. The third group consists of trees which may be called "resistant," for they may be thus described at least so long as the "wilt" remains as efficient as it is at present; they include pine, spruce, fir, junipers, cedars, poplars, chestnuts and many others.

Mixed forests are attacked somewhat in proportion to the presence of the favourite food-tree; that is to say, if, for example,

such trees are few, they will be completely defoliated and the caterpillars will then proceed to the nearest tree of whatever kind it may be. Undergrowth, if not of any favourite food-plant, is useful, because the caterpillars having devoured the leaves of a tree and having to pass through such undergrowth before reaching another of their favourite food-trees, almost of a necessity consume a large quantity of unsuitable food and consequently become more susceptible to the attack of the disease.

The author suggests that the natural remedy is to avoid the mixture of trees in forests. For example, in a pine wood with scattered oaks, the oaks should be cut down, in order that the pines, which are not attractive to the moth, may be entirely saved from attack. The whole question is now one for the practical forester rather than for the entomologist to settle.

Black Witch or Tick Bird.—*Agric. News, Barbados.* 4th Jan. 1913, p. 10.

This bird (*Crotophaga ani*) is an insect-eater found from South America to the southern United States and throughout the Antilles, with the exception of Montserrat, Antigua, and St. Kitts-Nevis in the British West Indies. Its occurrence in Dominica dates back only a very few years. Amongst its common names are:—Ani, Black Parrot, Savannah Black Bird, Tick Bird, Black Witch, Keel Bill and (in St. Lucia) Merle corbeau. In Jamaica it has been noticed eating Stink Bugs (PENTATOMIDAE), Cotton Stainers (*Dysdercus*) and ticks, and it also devours useful insects such as ladybirds and wasps. The question of its introduction into the island of Antigua has been raised, but inasmuch as many instances are known where the introduction of a species of bird or animal into a new locality, has produced conditions other than those which were sought, the matter requires careful consideration. The bird might possibly destroy more useful insects than pests, and it also feeds on seeds and berries.

FULLAWAY (D. T.). **Gall-Fly Parasites from California.**—*Jl. N.Y. Entom. Soc.* XX, Dec. 1912, pp. 274-282.

The author describes nine new Chalcidid parasites of gall-flies which have been bred by Mrs. R. P. Blakeman at Stanford University.

They belong to the following genera:—*Syntomaspis*, Först., *Ormyrus*, Westw., *Eurytoma*, Ill., *Decatoma*, Spin., and *Tetrastichus*, Hal.

CHAMPION (G. C.). *Acythopeus* (*Baridius*) *aterrimus*, **C. Waterh. in the orchid-house at Kew.**—*Entom. Mthly. Mag.* XXIV, Feb. 1913, p. 33.

A specimen of *Baridius aterrimus* has been found in the flower of a Venezuelan orchid, *Catasetum splendens*, at Kew Gardens. Mr. Jamie has described this insect as destroying *Phalaenopsis* and other orchids in Singapore. It has been found in conservatories at Torquay, Tunbridge Wells and Oxford.

Weiss (H. B.). **Notes on** *Lixus concavus*.—*Jl. Econ. Entom.* v, Dec. 1912, pp. 434-436.

This beetle, commonly known as the "Rhubarb Curculio," emerges from its winter quarters about the last week of May in the latitude of New Brunswick, N.Y. Eggs are laid soon after emergence and have been collected on the 1st June on the stems of dock, *Rumex crispus*, which is undoubtedly the favourite food-plant of the larvae. Oviposition ceases about the middle of June. The larva first enlarges the egg cavity and then cuts an irregular channel down the stem to the roots, where it remains and feeds till full-grown. The first larva hatched bores down the stem to the root, eating any eggs or larvae it comes across on its way. Those that hatch later seem to follow the course of the first and to be eaten by it when they reach the cavity in the root. The larvae attain maturity in 8 or 9 weeks; the majority pupate during the latter half of August and there are many adults about in the first week of September. The pupal period, in the laboratory, was found to be 10-12 days; and the pupal cells are on a level with the surface of the ground. The beetle on emergence feeds somewhat on young leaves at the base of the dock, but they are so scarce after the first week in September that they apparently go into winter quarters soon after emergence.

If *Rumex crispus* is cut several inches from the ground between the middle and end of July and rain then falls, a large percentage of the larvae die owing to the decay which sets in.

Wodsedalek (J. E.). **Life History and Habits of** *Trogodesma tarsale* **(Melsh.), a Museum Pest.**—*Ann. Entom. Soc. Amer.* (Columbus), v, Dec. 1912, pp. 367-381.

The author describes the larvae and pupae, and quotes cases of damage done to insect collections. In the U.S.A. this Dermestid beetle is distributed from coast to coast, being specially abundant in the Northern States, and when once introduced into a building is by no means easy to exterminate.

T. tarsale may be found in all stages of development throughout the year in well heated buildings. The author has obtained two generations and part of a third in a museum in one year. Pairing usually takes place the day after emergence from the pupa, and within 3-5 days later from 3 to 60 eggs are laid; the larvae hatch on an average in 12 days and do not wander far unless food is decidedly poor or scarce. It was constantly observed by the author that certain of the larvae refused to pupate, but continued to feed for over two years after attaining full growth; several have lived for more than $3\frac{1}{2}$ years. Pupal period, 11-17 days; life of adult, 10-32 days. Dried insects and fish appear to afford the best food, but young larvae placed at once after hatching on a feather diet have lived more than two years; though at the end of that time they were only the size of well fed larvae 14 days old. They have been shown to be capable of living on red pepper, seeds and meals of all kinds, and it would appear that they are often attracted to grain by the dead weevils, eating

the grain when the supply of dead insects fails. It has been shown experimentally that the larvae will live a year or more without food.

Severin (H. H. P.) & Hartung (W. J.). **The Flight of Two Thousand Marked Male Mediterranean Fruit Flies** (*Ceratitis capitata*, **Wied.**).—*Ann. Entom. Soc. Amer.* (Columbus), v, Dec. 1912, pp. 400-410, 1 pl., 1 map.

The authors marked 2,000 male flies by cutting off a portion of one leg. They were kept in jars and fed on molasses until the wounds had healed, and were then set free on the outskirts of Honolulu, in Manoa Valley. This valley is 2 miles long, varies in width from one mile to half a mile and is walled in by mountains 2,000 to 2,500 feet high. At the head of the valley, in a circle about half a mile in diameter, 50 kerosene traps were wired among the branches of citrus, fig, guava and other trees. It was found on a previous trial that of every thousand Mediterranean fruit flies captured in kerosene traps only three were females and therefore only males were used and these were liberated in lots of 200-500 each. Nearly all were captured within 15 days of liberation at points varying from a quarter mile to 1½ miles from the starting place, the flight being greatly influenced by the wind. As the prevailing wind is from the mountains, which are covered with wild guavas in which the pest breeds in enormous numbers, the writers express doubts as to the utility of the clean culture methods recommended by the Board of Agriculture of the Hawaiian Islands.

Severin (H. H. P.), Ph.D. & Hartung (W. J.). **Will the Mediterranean Fruit Fly** (*Ceratitis capitata*, **Wied.**) **breed in Bananas under Artificial and Field Conditions?**—*Jl. Econ. Ent.*, Concord, N.H., v, Dec. 1912, pp. 443-451.

The authors summarise their results as follows:—

We are hardly justified in drawing conclusions as to whether or not the fruit fly will breed in green Chinese bananas under natural conditions from the results of the investigation carried on under artificial conditions.

From 452 eggs which were placed in different parts of green Chinese bananas, only two fruit flies succeeded in completing their entire life-history. One hundred of these eggs were planted within the peel of the bananas and 4 days later 69 eggs had hatched; but all of these maggots died, probably from the effect of the tannic acid. From Chinese bananas which were not quite so green as those used in previous experiments, 42 per cent. of the eggs that had been inserted within these gave rise to adult flies. The majority of the maggots that were inserted when they were about half-grown within the pulp of the fruit died in the acid medium. Nearly full grown maggots, when placed within green Chinese bananas, usually completed their larval development, but often pupated within the fruit.

Mediterranean fruit flies were bred both under artificial and field conditions from ripe and over-ripe bananas with the peel intact and from ripe bananas with the pulp exposed. Under laboratory conditions, the peel of a green Chinese banana was removed around a longitudinal split extending within the pulp; decay set in along this crack and from this banana fruit flies were also bred. Under field conditions, green Chinese bananas were hung among the branches of lemon trees; and from these bananas, when they became ripe and over-ripe, adults were reared. Fruit flies also emerged under field conditions from two bananas which were removed from the bunches of banana trees that had been cut down during the mosquito campaign in Honolulu. One of these fruits was decayed at the flower-scar and a bruise extended through the peel beneath this region; this banana was yellow in colour below the decayed area and gradually shaded over to green towards the attached end.

Report of the Dept. of Agriculture, Nairobi, British E. Africa, 1911-12.

Mr. T. J. Anderson reports considerable damage to wheat by aphis, *Toxoptera graminum*, a pest first recognised in America in 1882, since when there have been several more or less destructive outbreaks of it in the Southern States. It has done great damage in Italy, Hungary and Belgium, and was reported from Bloemfontein, South Africa, in 1907. It is known in Western Canada, but not in the East. The food-plants include oats, wheat, spelt, barley, oat-grass, couch-grass, wild barley and maize.

This aphis south of 33° N. lat., except at high altitudes, breeds all the year round without the production of true sexes. Dry hot summers appear to be fatal to it, unless there be a large supply of succulent food. Its average life is 26 days and there is an average of 13 generations in the year; the first young appear about 6 days after birth and the average number produced by one aphis is 28·2. Temperature has a great influence upon its numbers and it is possibly for this reason that sexual forms and eggs occur, so far as is known, only over the northern portion of its range. In America outbreaks have occurred only after winters with a temperature above normal, followed by springs with a temperature below normal. One of the most important natural enemies of *Toxoptera* is a Braconid (*Aphidium testaceipes*) which lays its eggs in the body of the aphis, the imago emerging in about 15 days. During this period the capacity of the aphis for damage is diminished and the average of young is reduced to a maximum of eleven. It has been found that one *Aphidius* will parasitise as many as 206 *Toxoptera*. The parasite is not active much below 56° F., whereas the aphis will reproduce at or even below 40° F.

The most effective remedies against the pest are the ploughing up of infected areas, to be followed at once by harrowing and rolling. Covering infested spots with straw and burning was found to prevent the spread of the pests; spraying, rolling and

brush-dragging are not satisfactory remedies. Crop rotation and keeping the ground thoroughly clean and free from weeds or self-sown grain should be practised.

Wheat was first grown in Njoro in 1907-8 and the aphis was first noticed in 1909-10, about 25 acres on one farm being attacked. The attack was repeated in the next year over 60 acres on the same farm and slightly on another about 3 miles away. In 1911-12 over 3,000 acres of wheat were destroyed (50 per cent. of the area) and of the remainder much was damaged. The total loss was estimated at 60 per cent. of the crop, not all however due to aphis attack, unequal distribution of rain being responsible to some extent. Heavy rains acted as a check, but when these were over the pest became more serious than before; the growing points were attacked and the plants ultimately killed. In some cases the aphis appeared to turn back across the wheat-fields on reaching the rough grass outside, which was presumably distasteful to it.

Paddock (F. B.). **The Sugar-beet Web-worm** (*Loxostege sticticalis*, **Linn.**)—*Jl. Econ. Etom.*, Concord, N.H., v, Dec. 1912, pp. 436-443.

This Pyralid moth did great damage in the sugar-beet fields of Colorado in the summer of 1909—a similar but shorter outbreak having taken place in 1903. F. H. Chittenden (Bur. Entom., Bull. no. 33) says that the insect is an importation from abroad. It was found in Utah in July, 1869; in Central Missouri in 1873; first appeared in Colorado in 1891, but did not become a pest till 1903; first outbreak as a pest in Nebraska, 1893; in Michigan, 1899. This species is known to European entomologists as *Eurycreon sticticalis*, L.

Food-plants:—Pig-weed (*Amarantus*), lamb's quarter (*Chenopodium*), beets, onions, cabbage and lucerne in America. In Europe on a pig-weed (*Artemisia*), bind-weed, wolfsbane, corn, the blossoms of plum, apple, cherry and peas, and grasses.

Losses:—Growers estimate these at 35-55 per cent. in tonnage, 2-5 per cent. of sugar content and a corresponding decrease in the purity of the juice.

Review of the season of 1909:—At Sterling, Colorado, 18th-30th June, moths of the first brood numerous on weeds and alfalfa near beet fields; by 15th July, moths of second brood numerous in beet fields; 25th July, general outbreak of the worms over entire district, moths becoming scarce; maximum of larvae 26th-31st July; much spraying was done 1st-12th August; by 23rd August moths of the third brood were numerous in areas badly eaten by last brood and spread to the leaves of beet surrounding the damaged area; by 29th August the moths were becoming scarce and unable to fly; parasites, *Agathis* (*Cremnops*) *vulgaris*, Cress., taken 30th August; moths entirely disappeared by 1st September. Lantern-traps failed against the second brood; they were put out too late, as the moths fly at night only during the first few days after emergence. Paris green was used as a spray without effect

and the beet leaves were badly burned by it; white arsenic gave the same result; tobacco decoction (1 lb. stems to 1 gallon water) was effective, killing the larvae without damage to the leaves. Kerosene emulsion (10 per cent.) was found useless.

Season of 1910:—An outbreak was expected and the following observations made, again at Sterling, Colorado. On 13th May, a few moths noticed on weeds some distance from the beet fields; cold and wind retarded activity; fertilisation not general till 30th May. First eggs observed 8th June; by 17th June caterpillars abundant, moths practically disappeared; parasites taken frequently from 21-29th June. On 11th July moths of second brood were taken; by 13th July they were very abundant, though localised; the first eggs were seen on the 16th and the moths were spreading over the entire fields; the maximum of larvae was reached about 22nd July; parasites of this brood were plentiful and clearly affected the number of caterpillars. A few moths of the third brood were seen on 1st August, but there were hardly any larvae of the brood owing to the operations of the parasites.

Season of 1911:—Very few moths and these mostly on weeds and in neglected places; no injury to beet and it will probably be several seasons before the pest becomes serious again.

Life-history:—This species is active at night only in early life and never after egg-laying has begun. The moths are very active during the day, laying their eggs on the under sides of the leaves; if disturbed they do not fly far. The eggs have been estimated at 500-700 per moth, and are usually deposited singly, but sometimes in rows of 3 or 5 overlapping. As a rule the moths are seen 7-10 days before any larvae are found. The larva lives 14 days, but does not eat during the last 3 or 4 days. The injury is done so quickly, often within 36 hours, that the farmers imagine the pest to have migrated from adjoining fields during the night. A peculiarity of the attack is that it is always towards the centre, rarely or never along the edges of the field. A small area of attack spreads daily, the moths laying their eggs radially from a centre. Fields specially weedy in the previous season seem to suffer much. Soil has no bearing on the attack; one field may be attacked and the next untouched. The young tender leaves are always the last to be eaten. The beets are rarely touched and the crown hardly ever destroyed. Badly gnawed beets usually put out 3 or 4 small crowns of leaves. Pupation takes place in the ground in a tough silken cocoon, $\frac{1}{2}''$ to $\frac{3}{4}''$ below the surface. Hibernating larvae pupate in May and soon emerge as moths. These yield the June brood of larvae, which are seldom observed and are not abundant; they are found on goosefoot, pig-weed and alfalfa.

The second brood reaches its maximum in the latter half of July, is very short-lived and requires only 14 days for the appearance of the moths. This is often *the* destructive brood, feeding entirely on beets. The third brood reaches a maximum in the latter half of August and is often also very destructive; the larvae enter the ground to hibernate, though a few pupate and emerge as moths late in September. There thus may be three full broods and a partial fourth in a season.

Remedies:—Lantern-traps used early (see above), and large fires at night in adjoining fields are useful. The fields must be kept free from weeds. Where fields are irrigated, a small stream of water will localise an attack. Autumn ploughing will do more than any other farm operation to prevent an outbreak, by exposing the cocoons and larvae to birds and frosts; crop rotation is also a great aid. Arsenate of lead as powder or spray, applied early, seems to be the best insecticide; 2 lbs. dry powder per acre, or 2 lbs. in 50 gallons of water as a liquid spray. If Paris green be used 1 lb. per acre dry, or 2 lb. to 50 gallons of water with 1 lb. lime added, is all that can be safely applied.

Natural enemies:—Blackbirds, meadow larks, English sparrows and quail; in Europe the sparrow heads the list. This pest is unusually subject to parasites, *Agathis vulgaris*, Cress. (Braconidae), being the commonest, and laying its eggs either in the larva or the pupa. A secondary parasite *Mesochorus agilis*, Cress. (Ichneumonidae), limits its numbers however. A short bibliography is appended to the paper.

Bartlett (O. C.). **The North American Digger Wasps of the Subfamily** Scoliinae.—*Ann. Entom. Soc. Amer.* (Columbus), v, Dec. 1912, pp. 293-340, 1 plate.

The author describes nineteen species and two genera, four new species and one unidentified subspecies. Latreille regarded *Scolia punctata* as parasitic upon a certain species of bee building in old wood; Shuckard has caught it entering the cells of *Osmia bicornis*, and this has been confirmed by Robineau Desvoidy. Ashmead says that, so far as known, the species are parasitic on the subterranean larvae of beetles of the family Scarabaeidae, many of which are important agricultural pests. Burmeister was of opinion that *Scolia campestris* in Brazil lives in ant-hills and feeds on the larvae of *Atta cephalotes*, the leaf-cutting ant. There would seem to be a considerable body of evidence that the larvae of Scoliidae prey upon the larvae of a great many different insects and further investigation of their habits is very desirable.

Houlbert (C.). **Dégâts Produits par** *Criocephalus rusticus* **dans les bois de construction.** [Damage caused by *C. rusticus* in building timbers.]—*Insecta*, ii, no. 24, Dec. 1912, pp. 302-310, 1 pl., 6 figs.

Specimens of roof timbers were sent in May, 1912, by the architect of the Department d'Ille-et-Vilaine to the entomological station at Rennes. These timbers, the ordinary fir of the district, were seriously damaged by Longicorn beetles (*Criocephalus rusticus*), which in some cases appeared to have emerged by piercing plates of zinc. The timbers were reduced to a mere shell as thin as writing paper, and in two cases at least (fig. 2) the insect had bored through the solder which had been used to repair nail holes in the zinc plates. The metal penetrated had a hardness of 3, as compared with lead, 1·5. The following

Coleopterous larvae are stated to be capable of boring metal:—*Bostrychus capucinus*, L., *Callidium sanguineum*, L., and *Hylotrupes bajulus*, F.

A bibliography of the subject of metal piercing by insects is appended.

Surcouf (J.). **Note sur deux Insectes Parasites des Cultures en Algérie.** [Note on two insects living on cultivated crops in Algeria.]—*Insecta*, ii, no. 24, Dec. 1912, pp. 311-313, 2 figs.

The summer of 1912 in Algeria was very dry and certain insect pests which were believed to be on the decrease broke out again in serious numbers. The maize at Rocher Blanc, near Corso, was partly destroyed by a Noctuid, *Sesamia vuteria*, Stoll (*nonagrioides*, Lef.). The caterpillars, which are almost colourless, live in the interior of the spathes and devour the young cobs; millet and sorghum were attacked when maize was wanting, also canes.

The orange trees were badly attacked by *Ceratitis capitata*, Wied.

Harrison (J. W. H.). **An Unusual Parsnip Pest.**—*Entomologist*, xlvi, Feb. 1913, p. 59.

The writer noticed in North Durham last year enormous damage to seed in parsnip plants. The flowers and immature seeds seemed to be spun together in masses through which silk-lined tunnels passed in all directions. No seed was produced and in many cases the plants were killed. Two larvae were obtained from one plant and proved to be those of *Depressaria heracliana*. The natural food-plant of *Depressaria* is *Heracleum sphondylium*. Both the plant and the pest are known in Canada.

The best remedy appears to be to hand-pick the flowers of the parsnips late in June or early in July. The attacks of ichneumons are of no importance; not 1 per cent. is parasitised. The common earwig is more effective, destroying hundreds of pupae.

Maxwell-Lefroy (H.). **The Psylla Disease of Indigo in Behar.**—*Agric. Jl. of India*, viii, pt. 1, Jan. 1913, pp. 1-25, 4 plates.

The indigo crop of Bengal was estimated to have been reduced about one-third in 1890 by the attack of an insect then named *Psylla isitis*; it occurred in South Arcot in 1905 and has been found in Cawnpore in 1912; in 1907 it was abundant in Behar, where it was believed to be indigenous. Two possible reasons for this outbreak were suggested, namely, unusually favourable weather and the cultivation of the Java plant throughout the year, which serves to maintain the insect through the winter. Indigo is still grown in Madras, the United Provinces, and the Punjab on the old system in use before Java indigo was introduced, and although *Psylla* is found in these localities, it is not

a serious pest, being completely kept in check by natural causes. The author believes that the change in the method of growing indigo explains its remaining as a serious pest in Behar.

Existing diseases.—The Java plant of to-day differs markedly from the plant grown in 1905-06 when Java was first introduced. Two distinct diseased conditions are noticeable:—(*a*) the plant grows weakly, the leaves droop, wither and turn black, and the shoots die; this rarely occurs in "Moorhun" plants; (*b*) the leaflets become crisp, curl longitudinally towards the midrib, turn yellow and fall off; in place of the long growth there is a smaller cluster of leaves at the tip of the shoots, which eventually dry up. The author regards these two appearances as distinct, and they may occur on the same plant; the latter condition having as yet no name he calls it "X." When *Psylla* is present the leaflets curl irregularly; the apical shoot curls into a compact knot with the leaflets, and it is almost always only the tip which is affected. If the *Psylla* remain long on the plant the tip dies and side shoots develop. This has been proved in the laboratory. The author is convinced that the only disease of indigo for which *Psylla* is responsible is that in which the tips and leaves curl, and this for the following reasons:—(1) Java indigo at Cawnpore shows no other disease than that due to *Psylla*; (2) plants grown in the insectary and well infected with *Psylla* show no symptoms of either of the other diseases; (3) there is no correlation in the field between abundance of *Psylla* and large loss of plants from "wilt" or "X"; (4) plants growing in the field, and showing all forms of disease do not show any less increase of "X" when *Psylla* is kept down by spraying than when it is not; (5) Sumatrana indigo is heavily infested with *Psylla* and shows no sign of "X"; (6) the localised occurrence of "X" on individual shoots bears no relation to the relative occurrence on these shoots of *Psylla*.

The author regards the "X" disease as the chief cause of loss and that there is an organism or a definite physiological cause quite independent of *Psylla*, the part played by the insects being well-known.

Effects produced by Psylla *on the plant.*—The results of *Psylla* attack are different in the two varieties owing to their different habit and structure; the Java tip curls into a hard knot, that of the Sumatrana into a less compact mass. Curling is caused by the operations of one or two nymphs and generally begins about two days after they are put on the plant. The curling is not permanent; a plant infested on 17th Feb. was free from *Psylla* on 1st March, and by 29th March the curling had disappeared; the adult forms do not cause this malformation. In 1907 Sumatrana was more attacked than Java; the reverse is now the case.

Life-history of Psylla.—The eggs are laid singly on the stem, leaf-stalks, or leaflets. On hatching the nymph moves away from the egg-shell, feeds by sucking the plant juices, and moults five times at intervals of two to five days; it then reaches the state of a perfect winged insect; the nymph is nearly as flat as a common bed-bug. The females begin to lay eggs three or four days after becoming winged, and continue to lay during 8-26 days,

but usually die in 14 days; the males die sooner. The total period of a generation is from 23-33 days, shorter in hot weather, longer in cold. It is certain that the adult is not dependent upon indigo, but can live on other plants, though it does not lay eggs on them. The nymph stage however is passed on the indigo plant and only there, the period from the egg to the final moult lasting not more than 20 days in warm weather. The average number of eggs laid is put by the author at 500; a range of 274-828 has been observed.

In Dec.-Jan. winged adults and some nymphs are to be found on the young Java or on the plants left over for another year; these breed in March or earlier, according to the season, and from March onwards breeding is slow. In June-July the crop is cut, and if there be standing indigo alongside, the *Psylla* can transfer themselves to these plants. A number live on the cut stumps; when these are covered all but the winged ones perish, and the latter either fly to indigo elsewhere or live over on other plants till the indigo grows again; in the latter case they start egg-laying and breed rapidly till November, when the cold checks them and they live on without breeding until February.

If the cutting of the crop be properly done nearly all the nymphs are carried off with the plants; mainly winged adults are left, and as there are no nymphs for the enemies to feed upon, they go elsewhere. When the crop grows the adult *Psylla* is still there and can breed unchecked; in this way the enormous increase in July and August can be accounted for.

Food-plants.—The cultivated indigos of India are regarded by Prain as introduced plants. It is thought that the *Psylla* is an indigenous insect and that it has acquired the habit of feeding on indigo; possibly it fed originally on some wild plant containing indican; Prain mentions *Indigofera linifolia* as growing wild in Behar. Trials have been made with other indigos; the nymphs will feed and develop on *I. oligosperma*, *I. pauciflora*, and *I. anil*, which however are not wild species in Behar; no success was obtained with *I.* (?)*tinctoria* or *I. linifolia*. It is almost certain that *Psylla* has a wild food-plant in Bengal, but it has not yet been found. *Psylla* reappears unaccountably after floods and on land planted for the first time with indigo and far distant from other indigo crops. In captivity the adult will live 40 days on indigo, but on no other plant tried has it lived more than four days. Prior to 1905-06 or thereabouts, Sumatrana was the indigo grown, and the author believes that if indigo were again grown on the old system *Psylla* would cause only minor damage. Seed cultivation should not be practised in Behar, and under no circumstances should indigo be grown from November to March.

Enemies.—Three Coccinellids (*Coccinella 7-punctata*, *Chilomenes sexmaculata*, and *Brumus suturalis*), a *Chrysopa* (*C. alcestes*), a Syrphid (*Pelecocera sp.*), a Mantis (*Hierodula westwoodi*), and a spider actually eat the *Psylla* nymphs, but possibly to a large extent only in the absence of other insects. There is also a parasite which lays its eggs on the body of the nymph and destroys it. The author thinks that a change in the cultivation of

indigo has at least temporarily upset the balance between *Psylla* and its insect enemies, and that for the moment *Psylla* has got the upper hand.

Preventives.—(1) Cut each plant as near the ground as possible and leave no shoots; (2) cut *every* plant, leave none; (3) cut as large an area as possible at the same time; (4) plough and hanger the crop after cutting.

The infestation is very rapid, *e.g.*, a crop sown in the second week of May at Pusa was badly infested before 3rd July. A plot cut on 12th July and every scrap of green stuff removed showed eggs on 28th July and curled heads on 31st July; this plot was about 50 yards from another.

The author repeats his remark that *Psylla* will remain a pest so long as the present system of cultivation is adhered to.

Direct remedies.—Shaking the plants will not dislodge the insects; lights do not attract them; trailing a sticky rope or cloth over the fields gives very poor results; cutting the tips in July was found useless, though the author thinks that if properly done by hand, not by machine, good results will follow; the cut tips should be kept in boxes covered with gauze or cloth and the cloth lifted daily to allow parasites to escape. Spraying with soap solution has been tested and found to give good results. Low surface tension is essential and the addition of creosote was found to raise it and so diminish its wetting power. (See below.)

The paper concludes with an account of the "Auto sprayer" and the cost of the operations. No spray has been found which will kill the eggs.

Vermorel (V.) & Dantony (E.). **Tension superficielle et pouvoir mouillant des insecticides et fongicides. Moyen de rendre mouillantes toutes les bouillies cupriques ou insecticides.** [Surface tension and wetting power of insecticides and fungicides; a method of increasing the wetting power of copper spraying mixtures or insecticides.]—*C.R. Acad. Sci.*, cliv, no. 20, 13th May 1912, p. 1300.

The authors find that, (1) solutions having different surface tensions have the same wetting power; (2) the wetting power varies greatly with the nature or physical state of the materials to be wetted.

The wetting power of a solution on plants depends upon the ease with which the liquid forms thin plates and on the resistance of these plates, rather than on the surface tension. Whatever may be known as to the wetting power of a solution in respect of a particular vegetable or other material, it is not possible to predict that it will behave in the same manner on other vegetables and other material.

The practical result of these physical researches is the discovery that gelatine is infinitely more active in destroying surface tension and promoting wetting than soap, and 10 to 15 grms. of gelatine dissolved in boiling water and added to each hectolitre of spray liquor will wet vines and young grapes perfectly.

Dyar (Harrison G.). **Notes on Cotton Moths.**—*Insecutor Inscitiae Menstruus*, i, 27th Jan. 1913, pp. 1-12.

The author gives a key to 27 species of moths belonging to the genera *Alabama* (1), *Cosmophila* (1), *Gonitis* (2), and *Anomis* (23), many of which are known to feed on the leaves of cotton in the larval state; taxonomic notes on each species are also given. One new species of *Gonitis* and six of *Anomis* are described.

Hewitt (C. G.). **Legislation in Canada to Prevent the Introduction and Spread of Insects, Pests, and Disease Destructive to Vegetation.**—*Dominion of Canada, Depart. of Agric., Expt. Farms Bull.*, No. 12, Second Series, 1912, pp. 36.

The object of this bulletin is to provide general information for farmers and others, who may be concerned in the importation of vegetation into Canada, as to the restrictions imposed by the Government in order to prevent the introduction of injurious insects and other pests.

The danger of such introduction is probably greater in Canada than in any other country. The importation of nursery stock is very large and this is liable to be infested with pests and diseases which do not occur in Canada, but which may establish themselves and do enormous damage because the chief means of control in the countries in which they are native, namely, their natural parasites and other enemies, are not usually brought with them into new countries; and it is a fact that most of the serious insect pests in Canada were not originally natives of the country, but have been introduced or have migrated. For example, the San José scale *Aspidiotus perniciosus*, Comst., originally introduced into the United States from Asia, was first recorded in British Columbia about 1894; the Pear Leaf Blister-Mite (*Eriophyes pyri*, Nalepa) was first observed in Nova Scotia in 1887; the Brown-tail Moth was originally introduced into the State of Massachussetts from Europe in 1890; the Narcissus Fly (*Merodon equestris*, F.) has been introduced from Europe into British Columbia and Ontario. (An account of the invasion of pests into Canada is given in Bulletin 9 of this series—Bulletin 4 of the Division of Entomology.)

Dominion Legislation.—The Destructive Insect and Pest Act, 9-10 Edward VII., is set out at length, and comprises regulations for persons importing nursery stock into Canada, and also instructions to Customs Officers.

Provincial Legislation.—The Provinces of British Columbia and Nova Scotia inspect and fumigate, if necessary, all nursery stock and fruit, etc., imported into the provinces. The Province of Nova Scotia fumigates and inspects stock coming from other parts of Canada only.

The Act under which British Columbia carries out these regulations is entitled The Agricultural Associations Act, 1911

(1st March), and the 3rd Schedule contains the following list of 36 insects officially recorded as pests:—

Angoumois grain-moth (*Sitotroga cerealella,* Ol.).
Apple aphis (*Aphis pomi,* L.).
Black scale (*Saissetia oleæ,* Bern.).
Black peach aphis (*Aphis persicæ-niger,* Er. Sm.).
Brown-tail moth (*Euproctis chrysorrhœa,* L.).
Buffalo tree-hopper (*Ceresa bubalus,* F.).
Cherry aphis (*Myzus cerasi,* L.).
Cherry scale (*Aspidiotus forbesi,* Johns.).
Codling moth (*Carpocapsa pomonella,* L.).
Cottony cushion scale (*Icerya purchasi,* Mask.).
Cottony maple scale (*Pulvinaria innumerabilis,* Rathv.).
European fruit scale (*Aspidiotus ostreæformis,* Curt.).
Fall canker-worm (*Alsophila pometaria,* Harr.).
Flat-headed apple-tree borer (*Chrysobothris femorata,* F.).
Granary weevil (*Calandra granaria,* L.).
Greedy scale (*Aspidiotus rapax,* Comst.).
Gipsy moth (*Porthetria dispar,* L.).
Hop aphis (*Phorodon humuli,* Schrank).
Lesser apple worm (*Enarmonia prunivora,* Walsh).
Mediterranean fruit fly (*Ceratitis capitata,* Wied.).
Orange scale (*Aonidiella auranti,* Mask.).
Oyster-shell scale (*Lepidosaphes ulmi,* L.).
Peach borer (*Sanninoidea exitiosa,* Say.).
Peach twig-moth (*Anarsia lineotella,* Zell.).
Purple scale (*Lepidosaphes beckii,* Newm.).
Putnam's scale (*Aspidiotus ancylus,* Putn.).
Raspberry root-borer (*Bembecia marginata,* Harr.).
San José scale (*Aspidiotus perniciosus,* Comst.).
Sinuate pear-tree borer (*Agrilus sinuatus,* Oliv.).
Soft scale (*Coccus hesperidum,* L.).
Strawberry crown-borer (*Tyloderma fragariæ,* Riley).
Strawberry leaf-roller (*Ancylis comptana,* Fröhl.).
Tent caterpillar (*Malacosoma americana,* F.).
West Indian peach scale (*Aulacaspis pentagona,* Targ.).
Woolly apple aphis (*Schizoneura lanigera,* Hausm.).
Yellow mealworm (*Tenebrio molitor,* L.).

The Province of Nova Scotia passed a San José Scale Act and a Black Knot Act in 1900, but the arrival of the Brown-tail Moth pointed to the necessity for more comprehensive measures and accordingly the Injurious Insect, Pest and Plant Disease Act was passed in March, 1911. This Act is quoted in full, as is also the Fruit Pest Act (10 Edward VII.) of the Province of Ontario and the Acts of the Government of Prince Edward Island to prevent the spread of the "potato bug" (April 27th 1883), and of the "black knot" on plum and cherry trees (April 19th 1895).

Gowdey (C. C.). **An Account of Insects Injurious to Economic Products and their Control.**—*Dept. of Agric., Uganda Protectorate, Entebbe,* 1912, pp. 1-32.

In this publication the author in the introduction gives a very brief description of the orders of insects and gives a list of

insects injurious to various crops, with a short account of each species and its habits, and methods of prevention and remedies, as follows:—

COFFEE.

Scale Insects (*Ceroplastes ceriferus*, And., *Ceroplastes galeatus*, Newst., *Ceroplastes vinsonoides*, Newst., *Pulvinaria psidii*, Mask.).
Mediterranean Fruit Fly (*Ceratitis capitata*, Wied.).
Coffee Beetle (*Stephanoderes coffeae*, Haged.).
Crickets (*Gryllotalpa africana*, P. de B.).
Boring Beetle (*Dirphya princeps*, Jord.).

CACAO.

Cacao Fruit Fly (*Ceratitis punctata*, Wied.).
Scale Insects (*Stictococcous dimorphus*, Newst.).
Cacao Beetle (*Adoretus hirtellus*, Castn.).
Plant Lice (*Aphis sp.?*).
Crickets (*Gryllotalpa africana*, P. de B.).

COTTON.

Cotton Stainers (*Dysdercus nigrofasciatus*, Stål, *Dysdercus pretiosus*, Dist., *Oxycarenus gossipinus*, Dist., *Oxycarenus hyalipennis*, Costa.).
The Leaf-footed Plant Bug (*Leptoglossus membranaceus*, F.).
Cotton Aphis (*Aphis gossypii*, Glover).
Bollworm (*Earias insulana*, Boisd.).
Millipedes (*Odontopyge sp.?*).
Scale Insects (*Pulvinaria jacksoni*, Newst.).
Cutworms (NOCTUIDAE).

RUBBER.

Scale Insects (*Pulvinaria psidii*, Mask.).
Castilloa Borer (*Inesida leprosa*, F.)
"White Ants" (*Termes bellicosus*, L.).
Thrips.

CITRUS TREES.

Orange Butterfly (*Papilio demodocus*, Esp.).
Citrus Psylla (*Trioza sp.?*).
Plant Lice (*Aphis citri*, Ashm.).
The Purple Scale (*Mytilaspis citricola*, Pack.).

SWEET POTATOES.

Sweet Potato Weevil (*Cylas formicarius*, F.).
Sweet Potato Caterpillar (*Acraea terpsichore*, L.).
Sweet Potato Beetle (*Conchyloctenia punctata*, F., var. *parummaculata*, Boh.).

PALMS.

Palm Weevil (*Rhynchophorus phoenicis*, F.).
Scale Insects (*Chionaspis substriata*, Newst., *Aspidiotus cydoniæ*, Comst.).

TEA.

Scale Insects (*Aspidiotus sp.?*).

A chapter follows on insecticides, with their methods of preparation and use, and a table showing the standard strength for sprays, with some directions for killing, preserving, and packing insects.

Noel (P.). **Les ennemis de l'arroche.** [Insect enemies of "Garden Orache" (*Atriplex hortensis*).]—*Bull. du Laboratoire Régional d'Entomologie Agricole, Rouen,* 1st quarter, 1913, pp. 6-8.

The author gives a list of no less than 57 insects which feed upon this vegetable, so that despite the freedom of its growth, it is not always possible to obtain a sufficiency of perfectly sound leaves for the purposes of the kitchen. The list comprises, 3 Coleoptera, 6 Rhynchota, 34 Lepidoptera, 11 Diptera, and 3 Acarids.

Dewitz (J.). **The bearing of Physiology on Economic Entomology.** —*Bull. Ent. Research,* iii, pt. 4, Dec. 1912, pp. 343-354.

In this paper the author draws attention to the fact that hitherto physiological research, so far as injurious insects are concerned, has been almost entirely neglected, whereas it should be made one of the main starting points in the study of insect pests.

So far back as 1787 lighted candles and fires were used for the systematic capture of the "vine moth" and the practical application of the phenomenon of phototropism for this purpose has now reached a considerable degree of perfection. [*Cf.* this Review, ser. A, pt. 1, pp. 8-9.]

The natural tendency of certain organisms and, among them, insect larvae, to seek contact with their fellows and to squeeze themselves into corners, has made the capture of certain caterpillars possible by simple methods such as the fastening of belts, paper bands and strips of cloth around trees and vines, and has led to the use of flat stones or wooden boards for catching earwigs and slugs. Attention is also drawn to observations which have been made on the tendency which has been noticed amongst certain insects to fly against the wind. The sense of smell in insects and the use to which it has been put since 1910 for capturing the "vine moths" is referred to. The author then proceeds to discuss the influence of heat and cold upon insects and their larvae. It would appear that only when cold occurs suddenly after mild temperatures or out of season, does it become fatal to insects. On certain species, however, cold has a peculiar effect, which is equally observable in normal winter time as in the colder regions of high mountains or in the Arctic regions. Such insects, and the females in particular, especially of Lepidoptera and Diptera, become wingless. This result has been obtained experimentally, and the author comes to the conclusion that wingless insects result only when cold is applied to pupae and nymphs. Great humidity has the effect of stopping the spinning of the cocoons of many larvae; this is probably due to some balancing of osmotic pressure between the silk fluid within the caterpillar and the moisture in the external air. The author has also observed in the case of *Lasiocampa quercus* and *Eriogaster lanestris* that there is apparently a definite time of day at which the caterpillars spin. He has some hope that a careful study of the effect of these

external conditions in hastening or delaying the development of the insect, may result in some practically useful method of applying the knowledge gained.

The author points out how little is known of the real mode of operation of many useful insecticides, and that in many cases their supposed mode of operation is probably not the real one. He lays great stress upon the effect of a diminished supply of oxygen to insect larvae and is inclined to believe that the fatal effect of "contact" insecticides, whether liquid or powder, is due to their action upon the sense organs of insects, and that they do not merely cause suffocation, as is generally supposed.

The paper concludes with a full bibliography of the subject.

Buttrick (Philip L.). **Notes on Insect destruction of fire-killed timber in the Black Hills of South Dakota.**—*Jl. Econ. Entom.*, v, no. 6, Dec. 1912, pp. 456-464.

In this paper an attempt is made to give an outline of the results of the work of insects following forest fires in the Black Hills of South Dakota and to suggest remedies for their depredations.

Western Yellow Pine (*Pinus ponderosa*) is the predominant tree and the only commercial tree found, occurring unmixed over large areas. The chief insect enemy, the "Black Hills Beetle" (*Dendroctonus ponderosa*, Hopk.) is too well known to require description. It is now controlled by natural agencies, and by cutting large bodies of infested timber, for which a careful watch is kept. A leaf-scale, probably *Chionaspis pinifoliae*, occurs chiefly on seedlings and saplings, its attack being sometimes fatal. The climate is dry and fires numerous and severe, especially in the young growth. Many thousands of feet of otherwise merchantable timber are killed annually. Much of this is never used and methods of preventing its destruction by insects are therefore valuable. The chief insects infesting dead timber in the Black Hills are the ambrosia beetles, *Gnathotricus sulcatus*, Lec., and *G. occidentalis*, Hopk. They appear to attack injured rather than dead trees. The adults seem to fly throughout the growing season, and to hibernate in their burrows during the winter. Several generations are doubtlessly produced in a season.

The Cerambycid and Buprestid beetles, whose larvae make large burrows deep into the wood, are more important than the ambrosia beetles. The chief damage is done by a Buprestid which is probably *Chalcophora virginiensis* (the Heartwood Pine Borer) or one of its western forms, *oregonensis*, or *angulicollis montana*. The adults fly in July and by the third week of that month the woods are full of them, but they disappear by the first week in August. The eggs are laid in holes cut in the bark, occasionally in living, but more often on recently dead trees. They hatch in a few days and under favourable circumstances they may enter the wood within a month, and in two months more will have bored into it two inches. The larval stage lasts till the following season and may last for two years. They cease operations when cold weather sets in and the wood freezes. If the timber be cut before

it is badly infested by the larger borers the work of the ambrosia beetles is usually removed with the slabs. The larger borers will in time so riddle a log that it is worthless except as firewood, and in a single season may reduce its value from 30 to 50 per cent.

Severity of attack by boring beetles varies with the season of the fire. It can of course take place immediately after one, only during the season when the adults are flying. The further removed from this period the fire occurs, the less will be the severity of the beetle attack, since the wood has more chance to dry out and the bark to become detached. The greatest damage follows upon fire occurring early in the growing season. The moisture of the wood produces fermentation and with the rise of temperature the larvae grow rapidly, becoming well established before seasoning of the wood and cold weather interferes. On a large area burned about the middle of June, infestation by the end of August was so severe that the ground under the trees was white with "frass," which could be seen drifting to the ground like a light snow, and the author declares that "the gnawing of the larvae sounded like the croaking of innumerable frogs." An area close by which was burned in March was much less severely infested. As wood-borers prefer moist wood, site has some effect on their attack. They are more frequent in places sheltered from the sun and winds. The Hairy Woodpecker is very common and seems to be the chief bird enemy of the Buprestid larvae. The best remedy against these beetles is naturally the prevention of fires, and the next best thing is to harvest the burnt timber at once, especially if it can be cut and sawn within six weeks. Cutting and barking the timber is effective but is more costly than might be supposed.

A secondary damage caused by the beetles is the introduction of the bluing fungus into the burrows, which stains the wood, even though the direct damage done by the insects may not be very great. Soaking the logs in a pond has been suggested as a method of killing the borers, but the process is slow and not possible for any large amount of timber. Experiments with poisonous solutions have not been made, but they might be of some use.

Britton (W. E.), Agric. Exp. Sta., New Haven, Conn. **Notes of the Season from Connecticut.**—*Jl. Econ. Entom.*, v, no. 6, Dec. 1912, pp. 464-466.

The walnut weevil (*Conotrachelus juglandis*, Lec.) has been so destructive for several years that it has been almost impossible to obtain fruit from the various imported and cultivated walnuts. The literature of the subject is very scanty, and the weevil has generally been said to breed in the nuts, but in Connecticut the larvae do much greater damage by burrowing in the shoots, causing them to wither and die before they can produce fruit. The bud moth (*Acrobasis sp.*) attacks the new growth. It produces three generations each season. A full account of the work done in relation to the walnut weevil will appear in the 12th Report of the State Entomologist of Connecticut.

B. H. Walden has studied a sawfly which has done great damage to blackberries near Newhaven. It has been described by Professor A. D. McGillivray as *Pamphilius dentatus*. The damage done closely resembles that of the peach sawfly. Spraying with lead arsenate has been found useful.

Pissodes strobi, Peck., has attacked the pine trees in Connecticut. Great damage has been done by the grubs of a species of *Lachnosterna* to grass, the roots of corn, strawberries and potatoes; while in one nursery 25 per cent. of the seedling pines, spruce and deciduous trees were eaten off underground.

Laphygma frugiperda, S. & A. (the fall army worm), has devastated lawns in three districts and has often been found feeding upon millet.

Alabama argillacea, Hübn. (the cotton moth), occurred two weeks later than usual, and not in such numbers as in previous years.

Porthetria dispar, L. (the gipsy moth) is now regarded as under control and in some places as wholly exterminated.

Euproctis chrysorrhaea, L. (the brown-tail moth), has spread southwards slightly since last year, involving portions of the towns of Brooklyn, Plainfield and Sterling.

Bucculatrix canadensisella, Chamb., though less abundant in the eastern portion of the State than in 1910, has been found over the whole State, and has done considerable damage to yellow birches in Litchfield county.

GARMAN (H.). **Notes from Kentucky.**—*Jl. Econ. Entom.*, v, no. 6, Dec. 1912, pp. 466-469.

San José scale has been spreading in Kentucky during the past two years. The cause is unknown, but the author suspects that improperly fumigated material, or material which has never been inspected, is arriving from other States. The increase in fruit-growing may also account for the gross increase of the pest. Chinch bugs have also been doing much damage locally, and there is a demand for the white fungus with which to destroy them. *Laphygma frugiperda* (the fall army worm) did a great deal of damage in the past year to millet and alfalfa, and to rye. This is the first time for more than 12 years that the damage done by this caterpillar has attracted the attention of farmers. *Alabama argillacea* (the southern cotton worm) appears suddenly at long intervals about the electric lights in cities, where it was very common on 23rd September 1911, and again in the late summer of 1912. As Kentucky is not now a cotton-growing State it would seem that this is a migrant from the southern cotton fields.

Diaphania nitidalis (the pickle worm) has been more destructive than ever before. Whole plantations of cucumbers and cantaloups being so badly damaged as to be hardly fit for market. It begins work on the cucumber when about 3 inches long and continues until they are of some size. A soft rot then sets in, which soon extends through the whole fruit. It has also been found feeding on squashes and simlins.

Oncideres cingulatus (the twig-girdler) has done more damage in the past year than usual to persimmon, hickory and pecan trees. The latter were also much damaged by *Grapholita caryae* (the hickory shuck worm). The buffalo gnat (*Simulium*) is very common locally on low lands along the Mississippi and Ohio and is a serious pest of horses, worrying them so much that it was necessary to apply a mixture of lard and coal oil to keep it away. *Thyridopteryx ephemeraeformis* (the bag worm) used to be very common, but its parasites have appeared in immense numbers and now seem to have all but exterminated it. *Odontota dorsalis*, amongst other leaf-miners, has done a considerable amount of damage to the black locust tree, a very common road-side shade tree in Kentucky. The grapes have been badly damaged by *Polychrosis botrana*. The writer says that it is not difficult to deal with this caterpillar by careful pruning, clearing away all rubbish, and spraying, as it is generally on vines that are somewhat neglected that it does mischief.

Amongst possibly useful birds the "crow black-bird" (*Quiscalus quiscula*), common about Lexington, sometimes occurs in such great numbers that the inhabitants complain bitterly of their noise and chatter when roosting in the trees and of the litter they make in gardens and grounds, but the author has examined a number of stomachs and found that 93·8 per cent. of the food consisted of insects, chiefly grasshoppers, the rest being fragments of beetles, with traces of a few other insects; no army worms were found.

Webster (R. L.). **Insects of the year 1912 in Iowa.**—*Jl. Econ. Entom.*, v, no. 6, Dec. 1912, pp. 469-472.

Lepidosaphes ulmi, L.—The low temperature of the previous winter appears to have kept this insect in check, and the author notes that although at the end of May and the beginning of June eggs were to be found, hardly a single living scale-insect was seen.

Carpocapsa pomonella, L.—The apple crop of 1911 in Iowa was heavy, while in 1912 the yield was only 15 per cent. of the normal, the codling moth having done very great damage. In some cases orchards which had not been sprayed were attacked by the first of August to such an extent that not a sound apple was left.

Phlegethontius sexta, Johanssen.—This insect was very abundant on tomato plants at Ames in the autumn of 1910, though heavily parasitised. Since that time larvae have been rare. The author puts this down to the abundance of the Braconid *Apanteles congregatus* in 1910, though the *Apanteles* cocoons were themselves much parasitised by two species of hyperparasites at that time.

Periodroma margaritosa saucia, Hübn.—This was reported as damaging alfalfa under the name of "army worms," but turned out to be the "variegated cutworm," which occasionally becomes so abundant that it adopts the habits of the true army worm.

Considerable local damage was done. The larvae were found to be heavily parasitised by Tachinid flies.

Macrosiphum solanifolii, Ashm.—This aphid is not generally considered a serious potato pest in Iowa, but in July it became very abundant on potatoes at Ames. The ladybird, *Hippodamia convergens*, with the aid of certain hymenopterous parasites, checked the outbreak.

Sanders (J. G.). Coll. of Agric., Madison, Wis. **A Remedy for Chrysanthemum Leaf-Miner.**—*Jl. Econ. Entom.*, v, no. 6, Dec. 1912, p. 472.

During the spring and summer of 1912 a very serious outbreak of the chrysanthemum leaf-miner, *Napomyza chrysanthemi* (Kowarz), occurred in two Milwaukee (Wis.) greenhouses which had imported infested chrysanthemums and marguerites from Boston. Similar injuries were reported from Chicago and other points. The growers were faced with the entire loss of the flowering plants caused by complete infestation of the leaves by the mining larvae of this fly. While experimenting with contact insecticides for their control, the nicotine solutions, especially "Black Leaf 40" used as a spray, with or without whale-oil soap solution, proved a complete and satisfactory control. One part of nicotine in 400 parts of water killed the eggs and larvae readily, as well as newly formed pupae. The pupae of all ages were killed with 1-200 nicotine solution. It is evident that the nicotine affects the larvae through the leaf epidermis by osmosis. Several types of Lepidopterous and Coleopterous leaf-miners were killed by the use of nicotine sprays in an experimental way, but time was not available for field tests. It would be advisable to test this method in the control of the blackberry leaf-miner which is a serious pest in some seasons.

Headlee (J.). **Preliminary Report of the Committee on Entomological Investigations.**—*Jl. Econ. Entom.*, v, no. 6, Dec. 1912, pp. 472-484.

The chairman of the Committee on Entomological Investigations publishes a list of researches in progress in Canada and the United States. A list of investigators willing to classify specimens is appended.

Gee (W. P.). **Preliminary List of the Scale-Insects of South Carolina, with some notes on the behaviour of *Lecanium quercifex*, Fitch.**—*Jl. Econ. Entom.*, v, no. 6, Dec. 1912, pp. 484-486.

The author gives a list of 26 scale-insects with their host plants. Seven of these are noted as greenhouse species. He has also made some observations on the phototaxis of *L. quercifex*, Fitch, which tend to show that these insects seek light. The scales of

this form occur towards the outer portions of twigs on the newer wood, and the attraction of light may possibly account for their position. A number of the young scales were placed in 95 per cent. alcohol containing a small amount of strong hydrochloric and nitric acid and their movements observed. The insects did not appear to be much affected.

ROEPKE (Dr. W.). **De nieuwe parasieten van het Cacao-motje en iets over parasieten in het algemeen.** [The new parasites of the cacao moth and on parasites in general.]—*Mededeelingen van het proefstation Midden-Java*, no. 5, 1912, pp. 1-21, 1 pl.

In the course of this paper the author draws attention to the question of the fertility of parasites, in that unless the parasite be more fertile than the host insect its power to keep down a pest is seriously diminished. Exact information on this point is greatly needed and especially as regards the parasitic hymenoptera (sluipwespen), though in certain cases there is no doubt that the capacity for reproduction is enormous. In the case of some members of the family CHALCIDIDAE fertility is increased by the remarkable faculty of "polyembryony," which is unique in the whole animal kingdom. This consists in the fact that each egg laid by the female in the body of the host, produces not one larva, as might have been expected, but a great number of larvae, and as a result the fertility of the insect is enormously increased.

The author then reviews several of the more important experiments that have been made in other countries in introducing parasites for the control of insect pests.

The outbreak of the *Chloridea* (*Heliothis*) caterpillar pest in the tobacco plantations of Sumatra led Dr. de Bussy to go to America where a species of *Chloridea* is found whose eggs are parasitised by *Trichogramma pretiosa*, Riley. All attempts to get parasitised eggs over from America in good condition for development failed. An intermediate breeding station was therefore established in Holland and the next supply of infected eggs came over from America alive, but when developed produced male *Trichogramma* only. Further consignments produced females and a number of generations were bred successfully and sent to the Deli Experiment Station, where the parasite is now being tested. (*See* abstract, *Rev. App. Entom.*, ser. A, pt. 1, p. 13.)

The paper concludes with some observations on the cacao moth (*Acrocercops cramerella*, Sn.) and the discovery of what Roepke believes to be three parasites in cacao plantations in Assinan. Until this discovery was made no parasite of the cacao moth was known to exist, despite diligent search by Drs. Zehntner and Roepke in infested plantations in Central Java and the breeding out of many hundreds of pupae in the hope of finding such a parasite. It was observed, however, in certain plantations in which nothing had been done to check the moth pest, that the amount of damage varied very greatly in different years. In one case the proportion of damaged to undamaged pods was as follows:—1907, 7:1; 1908, first crop, 28:1—second crop thrown away; 1909, first crop, 25:1—second crop, 18:1; 1910, first crop,

7 : 1—second crop, 35 : 1; 1911, no first crop—second crop, 12 : 1. In 1912, the parasite was found in this plantation and the figures were, first crop, 2·25 : 1, and second crop, 1·9 : 1; an improvement reasonably attributable to the operations of the parasite.

In five plantations in another district (Assinan) the ratio of damaged to sound pods was as follows :—

	A.	B.	C.	D.	E.
June 1911 ...	16 : 1	19 : 1	7·9 : 1	42 : 1	13 : 1
June 1912 ...	3·8 : 1	12·5 : 1	6 : 1	3·7 : 1	3 : 1

In 1911 the moth pest had hardly began to be serious in May, whereas in 1912 it began very early. The above figures refer only to plantations of the "Djati-roenggo" hybrid cacao. The following figures show the relative intensity of the attack on the two varieties grown in the same group of plantations.

	Java-Criollo.	*Djati-roenggo.*
March 1912	53·3 : 1	... 5·4 : 1
April 1912	26·5 : 1	... 3·6 : 1

As it was in the Assinan plantations that the parasites were discovered, it seems reasonable to suppose that the improvement was due to their operation. The figures show that the Djati-roenggo cacao is either less liable to the attack of the moth or more attractive to the parasites than the other variety.

The author describes and figures three species of Ichneumonidae bred from *A. cramerella*, which he denominates A, B, and C. [So far as can be determined from the drawings, the first two are considered by Mr. C. Morley to belong to the genus *Hemiteles*, Grav., while the third is referable to *Goryphus*, Holmg. (= *Melcha*, Cam.).]

Roepke (Dr. W.). **Over den huidigen stand van het vraagstuk van het rampassen als bestrijdings middel tegen de Cacao mot op Java.** [On the present position of the problem of "rampassen"* as a method of combating the cacao moth in Java.]—*Mededeelingen van het Proefstation Midden-Java*, no. 8, 1912, pp. 1-21.

The object of the author is to set before the cacao planters a clear and reasoned statement of the objects of the operation known as "rampassen," the results obtained, and the results to be hoped for by carrying it out in the light of the experience gained in the 10 years which have elapsed since this plan of combating the cacao moth was worked out by Dr. Zehntner. The operation is based upon a knowledge of the life-history of the cacao moth, and in Dr. Zehntner's words "the time comes when the plantation must be absolutely cleared of all fruits so that the past and the coming harvest may be separated by an interval, during which theoretically no moths are to be found." (Proefst.

* [The word "rampassen," which has been left untranslated throughout this article, is a technical term implying a series of operations, the principle of which is the removal from the trees at one and the same time as far as possible of every cacao-pod which is at that stage of its growth in which it is most liable to attack by the moth, and also of all pods which are already attacked. These having served their purpose as baits are sacrificed in order to save the remainder.]

Cacao, Bull. No. 5, p. 6.) In practice, careful account has to be taken of the setting of the fruits so as to reduce the loss of fruit which the carrying out of the "rampassen" might entail. The theory of the operation takes no count of a number of conditions which arise in practice and consequently the results do not always correspond with those theoretically to be expected. Among these conditions the following are the most important:— (*a*) The "auto-infection" of the plantations as the result of a few cacao-pods being overlooked in the "rampassen"; (*b*) infection from the outside, *i.e.*, from neighbouring gardens and from "dessa-cacao"; (*c*) the danger of infection caused by the indigenous food-plants of the moth known as "kola" and "ramboetan." The first condition can only be removed by the carrying out of the operation of "rampassen" with the strictest care. The author urges that only the most trustworthy persons should be employed and that so far as possible the same hands should do the work every year. In order to ensure that no pods shall be left behind, the plantation should be crossed and recrossed in different directions by the work-gangs more than once and that each gang should be fined for any pods they may have missed, the fines to be added to the wages of the gang that discovers them. Lastly, it is recommended that all other work should be abandoned while the operations are proceeding, for unless the "rampassen" be thorough and complete it is largely labour thrown away, and on those plantations on which it is not or cannot be carried out cacao cultivation is useless.

The danger of infection from neighbouring plantations is naturally the greater the nearer these are, and unfortunately no reliable observations have been made as to the power of flight of the moth; but inasmuch as the fully developed insect is a somewhat feeble creature, the need for anxiety on this account is perhaps not great. The danger may be reduced by planting the danger zone with something which will make a natural fence. A broad belt of coffee or of Hevea makes an excellent and profitable wind-screen, but kola must on no account be used, as this is one of the food-plants of the moth. Ficus may also be used for the purpose, but is less serviceable and must be planted at some distance because of its great root-spread, which is capable of damaging the cacao plantation.

"Dessa-cacao," which grows abundantly in some parts of Java, is a source of infection by no means to be neglected. If it cannot be subjected to the operation of "rampassen" it is best to uproot and destroy it altogether, though this is by no means always easy. "Ramboetan" presents even greater difficulties, but fortunately this tree bears its fruits at a more or less definite time of year; it is known however that in exceptional conditions it bears fruit at irregular periods and thus forms a link between the cacao and the moth. The fruit of kola is regularly more or less infected by the moth, and this plant must invariably be subjected to the process; this is however difficult and troublesome to carry out, because, as the trees grow old, they form a dense crown. A further difficulty arises in that the kola fruit ripens in a shorter time than the cacao, and is therefore attacked earlier by the moth. As the commercial value of the kola trees is not

great, it is probably better to uproot them and to use some other tree as a wind-screen, otherwise care must be taken that they do not grow too high.

Up to the present no other food-plants of the moth are known, and so much search has been made for them without result that it is improbable that any others exist. Auto-infection, *i.e.*, infection arising from the overlooking of infected pods and other material, is of far greater importance than infection from outside. When it is reasonably probable that everything has been done that can be done to prevent auto-infection and infection from the outside has been excluded by the destruction of all wild food-plants, yet moth infection nevertheless occurs, the explanation is probably to be sought in the carriage of infection by carts passing through the plantations, by crows and other birds which carry off the "ramboetan" fruit, and, last but not least, by human beings who carry the "ramboetan" fruits about and carelessly throw away the husks.

The next question to be considered is the period of its growth at which the cacao-pod is liable to moth infection. Dr. Zehntner found larvae on pods only 4-5 cm. long, but they were unable either to bore into these pods or to travel from them to others. He estimated that the percentage of infection for pods of various sizes was as follows:—7-10 cm., 1 per cent.; 10-12 cm., 12 per cent.; 12-15 cm., 45 per cent.

The operation of "rampassen" is facilitated by abundant space between the plants; by proper pruning; and by the absence of any intervening catch-crops. Abundance of air and light is also very necessary to the health of the cacao plant, and the operation is much more easily performed if the trees are kept down to a reasonable height. Nevertheless, pruning is not generally adopted in Java, and the practice of growing other crops between the rows of cacao trees has many supporters in the centre of the island. It has not been proved that mixed cultivation diminishes diseases and pests; this is not true of the moth and still less so in other cases. *Helopeltis* constitutes probably the solitary exception.

The best time to carry out the operation of "rampassen" is when the cacao leaves are small, for then the risk of overlooking even small fruit is reduced to a minimum. It is well known that the plants bear better when the fruit sets during wet weather rather than in dry, and in those plantations which are harvested twice in the year, the first crop, the fruit of which sets during the rainy season, is better than the second, which sets during the dry season, one reason being that the wet greatly hinders the operations of the moth and its larvae; but the author believes that this is not of so much importance as the fact that in these plantations the "rampassen" in December-January is far more thoroughly carried out than that of June-August.

Black ants appear to be of service against the moth, at all events plantations in which they are plentiful seem to suffer less: possibly by running over the pods they hinder the moths from laying their eggs.

All the above-named small factors in the problem are only of consequence when the moth pest is not serious. It is no use

systematically collecting pupae when the moths are swarming, the only plan is not to allow the pods to become too ripe before plucking, for in this case the larvae leave the pod and go to another; whereas a pod once plucked will not deteriorate further on account of its having been attacked. If the attack of the pest be so severe that the pods will not ripen properly, there is obviously no advantage in gathering them.

Rapid harvesting is very desirable, as even under the best conditions every harvest begins with some degree of infection in the pods and delay may mean the production of a second generation of moths during the work. Almost the worst that can happen is the ripening of a quantity of small pods before the larger ones; when this occurs, the further "rampassen" which is often carried out is, in the author's opinion, useless. The ripe fruits are, in practice, separated from those which on inspection appear to be attacked, and it is entirely left out of sight that the pods which are left will yield moths, or the period of growth of the fruit must be put so low that one might as well begin the "rampassen" over again and sacrifice the whole harvest. The largest proportion of the fruit should set immediately after the "rampassen" is completed, and if this does not take place but is delayed and irregular setting occurs, great damage may be done.

The inventor of the process was doomed to considerable disappointment on the first trial, for before the beginning of the second harvest there was evidence of the presence of the pest and it was clear that the results did not correspond with theory, and the question as to whether it might not be better to carry out the operation twice in the year arose. If there be only one harvest in the year it is clear that it can only be done once, but if there be two harvests then it is open to "rampassen" once or twice; if it be done once and so thoroughly that it can be said with certainty that no fruit is left and the plantation is absolutely clean, then once may suffice, but if not so thoroughly done then it must be done twice.

The question as to whether there shall be one or two harvests in the year is more or less at the discretion of the planter. If allowed to do so, the trees will bear in a fashion all the year through, but there are two periods of maximum which constitute the proper harvest times followed by a "slack" season of shorter duration during which there is little or no ripe fruit produced. Dr. Zehntner's idea was to convert this slack period into one of no fruit whatever, ripe or unripe, in the belief that once the whole supply of food was cut off the moth pest would cease.

The question as to whether the "rampassen" process should be carried out once or twice in the year is discussed at considerable length. There appears to be much difference of opinion on the subject, and the advantages and disadvantages of each system are fully set out. Dr. Roepke himself is inclined to favour the double operation, as experience has shown that it diminishes the chances of loss; although if the conditions are exactly suitable, the single operation may be more profitable in a particular year.

Two conditions are laid down as being indispensable for securing a good harvest:—(1) the harvest operations must be carried

out in the shortest possible time and must not extend over more than $2\frac{1}{2}$ to 3 months; (2) the possible yield must be at its maximum at the moment that harvest begins.

The question as to whether a certain time should be allowed for the setting of the fruit has been carefully considered by expert planters in council, but the difference of conditions prevailing in the various plantations has rendered any unanimous decision impossible.

The variety of cacao known as Djati-roenggo resists the attack of the moth better than Criollo. Not only is the proportion of pods at the beginning of the harvest considerably greater, but as the planters put it, "it keeps it up longer"; that is to say, the moth infection is much slower, though this may naturally reach a maximum sufficiently high to render the yield poor. One of the reasons for this greater resistance to the moth is the harder shell of this variety of cacao; the skin is also smoother and it has been fairly proved that rough-shelled pods are more attacked than smooth ones. This enables a larger number of pods to be spared during the "rampassen," though it is quite possible that they may be attacked just a little later. Djati-roenggo requires a longer time to ripen than Criollo, and this has to be set off against the less liability to moth attack. Probably the liability to attack would be still less if the Djati-roenggo ripened earlier, and it is obviously an inconvenience and also a cause of risk that the time of flowering and setting of the fruit is not the same as that of Criollo, at all events in the younger plantations. This cannot be altered at once, but it is hoped that later it may be made to coincide by regulating the operation of "rampassen" in the Djati-roenggo plantations.

Another benefit which results from the operation of "rampassen" is that it rids the plantation of all pods attacked by fungus. There is no doubt but that it must be regarded as the great annual cleaning up, and since the method has been adopted all manner of fungus pests have practically disappeared.

The burying of all waste pods and shells collected during the operation must be strictly attended to; the destruction of the shells is not of so much consequence, but every pod should be carefully buried or destroyed. Some planters think that the pits should not be disturbed for a long time, but as a matter of fact fermentation sets in rapidly, the mass heats, and moths, caterpillars and eggs are quickly destroyed; the same pit may, in fact, be safely used again within eight days, and the cacao shells make a good manure for the plantations.

Other methods of combating the cacao moth.

The hopes that had been entertained of fighting the moth by the introduction of parasites have been to a large extent disappointed, inasmuch as it has been found that the insects are themselves so attacked by other parasites that there is little or no chance of their multiplying sufficiently to be of any service. From several dozens of moth pupae only one or two parasites have been obtained, and there appears to be no hope of success until some means is found of destroying or preventing the breeding of the

hyperparasites; but the author thinks that the chance of being able to effect this is very small. It has been discovered that the parasite imported from America with such pains and labour busies itself with the eggs of other Lepidoptera and takes no notice whatever of those of the cacao moth. Whatever means of combating the pest may be discovered in the future, it is now abundantly clear that Dr. Zehntner's "rampassen" method is at present the only one on which the Java cacao planters can rely, combined with the patient selection and propagation of more or less moth-resisting varieties.

Barret (O. W.). **Roach-proof book-varnish.**—*Philippine Agric. Rev.*, vi, no. 1, Jan. 1913, p. 49.

The author recommends the following mixture:—

Wood alcohol or strong vino	...	1 litre
Carbolic Acid, full strength	...	30 grammes (1 oz.)
Corrosive sublimate ...	...	15 ,, (½ oz.)

The mixture, after shaking, should be allowed to stand for 24 hours before use and may then be applied with a piece of cloth or a small paint brush. It should not be used on soft leather or on bright coloured bindings. One application once every six months is sufficient.

The author has used this preparation successfully against cockroaches in Porto Rico, one of the worst countries in the world for these pests.

Destruction of Lantana.—*Jl. d'Agriculture Tropicale*, 1912, p. 154.

This plant in tropical countries becomes a nuisance on cultivated and pasture land, and attempts are being made in New Caledonia to destroy it by introducing a species of fly of the family Agromyzidae from the Sandwich Islands. Seeds damaged by the larvae of the fly have been found in the neighbourhood of Numea, but the experiment appears to be a somewhat risky one, as it is by no means impossible that the fly may turn its attention to some cultivated plant and prove a worse pest than the weed which it is hoped it will destroy.

Nakayama (S.). *Chilocorus similis*, **Rossi, and its relation to Scale-Insects in Japan.**—*Monthly Bull. State Commission of Horticulture, Sacramento, California*, no. 13, Dec. 1912, pp. 932-936, 1 fig.

The author states that this ladybird is exceedingly useful in Japan as it feeds on nearly all the scale-insects injurious to garden and orchard trees in that country. There are two generations in the year. The larva moults three times before pupation and the ladybird passes the winter in the adult stage, hiding under dead leaves or in the cracks of the bark. Observations as to generations are recorded. The insects deposited eggs on April

17th; these hatched on May 5th; pupation took place on 3rd June and adults emerged on the 14th. These same adults deposited eggs on the 17th June which hatched on 15th July, the larvae pupated on 12th August, and adults emerged on the 22nd August and hibernated through the winter.

The insects rarely feed on aphids, but almost entirely on scale-insects, preferring *Aulacaspis pentagona*, Targ., and *Aspidiotus perniciosus*, Comst. Observations on the amount of food taken by the insect gave the following results:—The larva hatched at midday, began to eat about 9 o'clock the next morning and in the first stage is not very voracious, not eating more than one or two young scale-insects per diem. Its appetite increases only in the fourth stage, that is to say, after the third moult, when it consumes more than 50 per diem; thus the larvae were found to eat from 700 to 800 Coccids in the total larval period, and the adult ladybird 800 to 900. The adult lives for about 35 or 36 days. Four ladybirds, observed throughout their life, actually devoured as larvae, 775, 752, 758, and 805 Coccids respectively; while in the adult stage they ate 886, 819, and 902; the fourth one died a fortnight before the others, after consuming 558. Both larvae and insects were fed upon *Aulacaspis pentagona*. The larva first makes a hole in the scale and then either pulls the body out through the hole or pushes its own head into it. The adult insect very commonly lifts the scale up and pulls the body out. A ladybird will eat a young scale-insect in a second, but it takes 20 to 25 minutes to devour a fully developed Coccid. The number of eggs laid appears to be 16 to 17.

Herrick (W. G.). **The Larch Case-Bearer.**—*Cornell Univ. Agric. Expt. Sta. Coll., Agric. Bull.*, no. 322, Nov. 1912, pp. 39-52, 15 figs.

The author describes this insect at length and its mode of attack. He states that there is but one brood in the year and that at the station three parasites, a Pteromalid, a species of the genus *Pachyneuron* and a Tetrastichinid had been bred out. He gives the following as having been bred from this insect in Europe:—*Bracon guttiger*, Wesm., *Microdus pumilus*, Ratz., *Campoplex nanus*, Gr., *Campoplex tumidulus*, Gr., *Campoplex virginalis*, Gr., *Anaphes* (?), *Entedon arcuatus*, Frst., *Entedon laricinellae*, Ratz., and *Pteromalus laricinellae*, Ratz. No practical method of control is known on forest trees over large areas, and on isolated ornamental trees arsenate of lead at the rate of 2½ lb. to 50 gals. of water sprayed on to the trees in April when the buds were just beginning to grow and again on May 5th, appeared to produce little or no effect. The following quotation from the report is specially interesting as showing the physical difficulties attending the effective use of these sprays:—

"In looking over the trees shortly after they were sprayed the poison was found to be invariably gathered in small globules at the bases of the leaves. The leaves of the larch are small, narrow, and glossy. The poison does not seem to stick to the narrow needles and consequently does not become well distributed

over the surface of the leaves. It is possible that a small quantity of soap added to the mixture would enable the poison to spread and stick better. Laboratory experiments with arsenate of lead gave very inconclusive results." (*Conf.* this Review, p. 46.)

"Lime sulphur," at the rate of 1 gal. to $8\frac{1}{4}$ gals. of water applied thoroughly to all the branches so as completely to cover the tree, was found to be really effective; the larvae being killed in their winter position.

PARROTT (P. J.) & SCHOENE (W. J.). **The Apple and Cherry Tree Ermine Moths.**—*New York Agric. Expt. Sta., Geneva, New York, Tech. Bull.*, no. 24, Nov. 1912, pp. 1-40, 9 pl., 1 fig. and map.

The discovery of *Yponomeuta padellus*, L., in the State of New York was due to the close supervision of foreign importations of nursery stock during the spring of 1909, which were instituted owing to the discovery of many nests of the brown-tail moth in imported material. The caterpillars in their webs were found on two occasions on cherry seedlings; practically all were destroyed, but sufficient were retained to enable six moths to be bred out which were identified by Dr. P. Marchal, of Paris, as *Y. padellus*, L. In spite of careful inspection at the port, caterpillars were found in 1910 on apple seedlings in various places. Very few were found on imported material in 1911 and still fewer in 1912, and it is hoped that the insect has not established itself in New York State. The authors devote much space to the distinctions between *Y. padellus* and *Y. malinellus*, and are of opinion that they are not separable specifically, though, in deference to existing opinion, they have treated them as distinct.

There is a native species of the genus *Yponomeuta*, viz., *multipunctellus*, Clem., which is common in Kentucky and feeds upon the leaves of *Euonymus atropurpureus*, Jacq. None of the well-known parasites of the moth have been reared from any of the material arriving in the United States on nursery stock, but a considerable number of specimens of a Tachinid fly, *Exorista arvicola*, Mg., were found on caterpillars taken from cherry seedlings in New York.

NOTICES.

The Review of Applied Entomology is intended to contain, month by month, abstracts of the latest information published concerning insects injurious to man or animals, as the carriers of disease; and to forests, fruit trees, crops or stored merchandise.

The Editor will be glad to receive prompt information of the appearance of new pests, or of known pests in districts which have hitherto been free from them, and will welcome any suggestion, the adoption of which would increase the usefulness of the Review.

Authors are especially requested to send to the Editor, as early as possible, copies of their papers for notice in the Review and for preservation in the Library of the Bureau, as it is hoped to form a complete collection of the literature of the subject.

Writers are also earnestly requested to send old reprints, as these are often very difficult to obtain.

Secretaries of Societies and Editors of journals willing to exchange their publications with those of the Bureau are requested to communicate with the Assistant Editor, 27, Elvaston Place, Queen's Gate, London, S.W.

The subscription to the Review is 12s. per annum, post free; or the two Series may be taken separately, Series A (Agricultural) being 8s., and Series B (Medical and Veterinary), 5s. per annum.

All orders and subscriptions should be sent to Messrs. DULAU & Co., Ltd., 37, Soho Square, London, W.

CONTENTS.

	PAGE.
Aphididae of the Hastings District	33
Indigenous African silkworms...	33
Gipsy Moth in the United States	33
Black Witch or Tick Bird in the West Indies	36
Gall-fly Parasites from California	36
Orchid pest at Kew	36
Notes on *Lixus concavus* in U.S.A.	37
An American museum pest, *Trogodesma tarsale*	37
Mediterranean Fruit-flies, Flights of	38
Mediterranean Fruit-fly in Bananas	38
Aphis pest of Wheat in British E. Africa	39
The Sugar-beet Web-worm in Colorado	40
North American Digger Wasps	42
Damage to building timbers by *Criocephalus* in France ...	42
Two insect pests of crops in Algeria	43
An unusual parsnip pest	43
Psylla Disease of Indigo in Bengal	43
Method of increasing the wetting power of sprays	46
Notes on Cotton Moths	47
Legislation against plant pests in Canada	47
Injurious insects in Uganda	48
Pests of "Garden Orache" in France	50
The Bearing of Physiology on Economic Entomology ...	50
Destruction of fire-killed timber by insects in S. Dakota ...	51
Injurious insects in Connecticut in 1912	52
Injurious insects in Kentucky in 1912	53
Injurious insects in Iowa in 1912	54
Remedy against Chrysanthemum Leaf-miner	55
Research work in progress in Canada and U.S.A.	55
Scale-insects of South Carolina	55
Parasites of the Cacao moth in Java	56
Method of combating the Cacao moth in Java	57
Cockroach-proof book-varnish...	62
Destruction of Lantana in New Caledonia	62
Chilocorus similis and Scale-insects in Japan	62
The Larch Case-Bearer in the United States	63
The Apple and Cherry Tree Ermine Moths...	64